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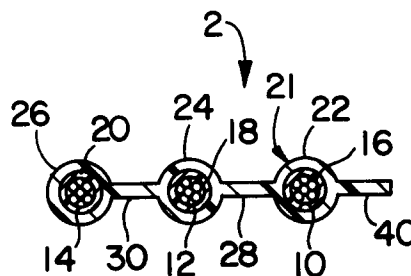
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CH DE FR GB IT LI SE(71) Applicant: **COOPER INDUSTRIES INC.**
1001 Fannin Street,
Suite 4000
Houston Texas 77002(US)(72) Inventor: **Johnson, John E.**
5965 Longford Road
Huber Heights, Ohio 45424(US)(74) Representative: **McCallum, William Potter et al**
Cruikshank & Fairweather
19 Royal Exchange Square
Glasgow G1 3AE Scotland (GB)(54) **Flat cable.**

(57) The inventive cable comprises a plurality of axially-spaced flexible metal conductors (10,12,14) which are each disposed within a layer of insulation (16,18,20) and a jacket (22,24,26). A solid web (28,30) interconnects the jackets (22,24,26), and, preferably, is integral with the jackets. The webs (28,30) have a thickness that is substantially less than the minor dimension of the cable, and the webs (28,30) and conductors (10,12,14) preferably lie in a common plane. A polarity wing (40) is provided that extends a predetermined distance from the jacket (22) of one of the end conductors (10), and is preferably integral with the jacket (22). The polarity wing (40) preferably has a thickness that is substantially less than the minor dimension of the cable. The polarity wing (40) and webs (28,30) extend diametrically opposite of the end conductor (10) so that the polarity wing (40) lies in the same plane as the conductors (10,12,14) and webbing. The polarity wing (40) provides a key-like effect to ensure that the cable is properly meshed with a connector. In this regard, the polarity of the various conductors (10,12,14) are preselected depending upon the system requirements so that the polarity can be readily determined based on the relative locations of the conductors.

**FIG. 2****EP 0 568 277 A1**

The present invention relates to electrical cables, and, more particularly, to a flexible flat-type cable that can be used with control systems such as heating, venting, cooling, lighting and computer controlled environmental systems.

Various types of cables adapted to provide electrical energy, i.e. power cables, are heretofore known. Such cables may be flexible, semirigid or rigid. It has also been known to construct flat power cables, which increase flexibility. An advantage in using flexible cables is that such cables are easier to install if they are intended to extend through walls, floors and ceilings.

Other types of cables are used in connection with communicating data in computer systems. This is the type of cable with which the present invention is particularly concerned. In view of the wide range of modern applications of computer systems, it often is necessary to install such cables not only through walls, floor, and ceilings but also through equipment and machinery. Most modern heating, ventilating and air conditioning systems, for example, are computerized and it is necessary to install such cables through plenum areas. The type of cables conventionally used with such systems are round cables, which are difficult to work with because tools are required for making various connections, including an insulation displacement connector (IDC), and because the round cables are difficult to install where there are clearance constraints. Another disadvantage in using round cables is that conductors within the cables must always be colour-coded so the identification of each conductor can be determined.

It is an object of this invention to provide a flat cable for use with computer and data control system and which can enable connection without the need for tools.

It is a further object of this invention to provide such a flat cable where prior removal of the outer most jacket is not required for connection.

It is further still an object of this invention to provide such a cable that can be used in plenum areas.

According to the present invention there is provided a flexible jacketed flat cable comprising:

a plurality of insulated conductors in spaced relationship with each other,

a separate one-piece jacket surrounding each insulated conductor and

a web interconnecting adjacent jacketed conductors, the thickness of said web or webs being less than the minor dimension of said cable.

According to a further aspect of the present invention there is provided a flexible jacketed flat cable comprising:

a plurality of insulated conductors in spaced relationship to each other,

a separate one-piece jacket separating said jacketed conductors by a plurality of webs being less than the minor dimension of said cable, and a polarity wing extending from said jacket and said polarity wing being integral with said jacket.

The present invention entails the use of flat cables in connection with control systems, i.e. computer and data control systems and particularly those systems employed in heating, ventilating and air conditioning systems. The inventive flat cable comprises a plurality of axially-spaced flexible metal conductors which are each disposed within a layer of insulation and a jacket. Most or all of the conductors are intended to be used to transfer data. A solid webbing interconnects the jackets, and, preferably, is integral with the jackets. The webbing has a thickness that is substantially less than the minor dimension of the cable (i.e. the diameter of the layer of insulation), and the webbing and conductors preferably lie in a common plane.

Preferably, the polarity wing, integral with the jacket, extends for the entire length of the multi-conductor cable. This allows the multi-conductor flat cable to be severed at any point and still be properly installed without tools when an appropriate corresponding key connector is used. The polarity wing preferably has a thickness that is substantially less than the minor dimension of the cable. Preferably, the polarity wing and webbing extend diametrically opposite of an end conductor so that the polarity wing lies in the same plane as the webbing. The polarity wing provides a key-like effect to ensure that the cable become meshed with the appropriate keyed connector. In this regard, the polarity of the various conductors are preselected depending upon the system requirements so that the polarity can be readily determined based on the relative locations of the conductors.

The phrase, "multi-conductor flat cable" refers to cables having insulated conductors properly spaced a predetermined distance between adjacent conductors within the cable and being covered by an appropriate jacket. The term "flat" does not refer to the surfaces of the jacket as being planar. The multi-conductor cable of the present invention has at least two insulated conductors.

Any number of insulated conductors may be incorporated in the invention, but in the preferred embodiment, three conductors are employed. Also, although the dimensions of the various components may also vary depending on the system requirements, such dimensions should comply with any applicable safety standards.

A preferred construction for a three conductor flat cable having a working voltage of 40 V RMS maximum, a working current of 4 amps maximum, maximum conductor resistance at 20°C of 11

OHMS/1000 Ft. and a capacitance at 1MHZ between conductors of less than 25 PF/ft is a multi-strand round conductor having a AWG 20 with a diameter of from about 0.94 mm (37 mils) to about 1.02 mm (40 mils) and preferably about 0.98 ± 0.013 mm (38.5 ± 0.5 mils); the thickness of insulation layers is from about 0.20 to 0.30 mm (8 to 12 mils) and preferably 0.25 ± 0.005 mm (10 ± 2 mils); the thickness of jackets is approximately 0.25 to 0.46 mm (10 to 18 mils) and the conductors are axially spaced a distance from their center line of from about 0.37 to 0.42 cm (0.145 to 0.165 inches) and preferably 0.40 ± 0.01 cm (0.156 ± 0.005 inches); the polarity wing extends from the outer surface of the conductor jacket and is spaced from the center of the outside or end conductor a distance of at least 0.25 cm (0.10 inches) and the distance from the periphery is preferably greater than the distance between adjacent conductors; and the thickness of the webbing and polarity wing preferably are equal and are preferably from about 0.38 to 0.64 mm (15 to about 25 mils).

The above-described cable offers many benefits. For example, because of the structure, an IDC connector having a corresponding key slot can be used and the connection made without the removal of the outer jacket and without the use of tools. the connection is made by piercing through the jacket and insulation with the connector contacts. Because of the polarity wing, and because the polarities of the conductors are preselected, the appropriate contact is always visibly and easily determined. Moreover, the polarity wing also obviates the need to use colour coding since the polarities of the conductors are preselected and will be evident based on the relative location of the conductors. Due to the design, it complies with the latest requirements of CMP and can therefore be utilized as a communication cable for air plenum installations. Finally, the flat cable is much more feasible to install through equipment and machinery having clearance constraints.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings in which:-

Fig. 1 is a top plan view of a flat cable in accordance with a preferred embodiment of the invention.

Fig. 2 is a cross section taken along lines 2-2 of Fig. 1.

A flat cable 2 in accordance with the preferred embodiment of the invention comprises three axially-spaced flexible metal conductors 10,12,14. Each conductor has a layer of insulation 16,18 and 20. A jacket 21 overlays the insulation, separates the conductors from each other and provides a key. The jacket provides individual conductor jackets 22,24,26 as shown in Figs. 1 and 2. The axially-

spaced conductors 10,12,14 lie in a common plane, and the outside conductors 10,14 are preferably equidistantly located from the central conductor 12, as shown in Fig. 2.

Conductors 10,12,14 are constructed of any suitable conductive material such as copper. The conductors are generally stranded conductors having an AWG size of from 25 to 16 and preferably 20. The layers of insulation material 16,18 and 20 and the jackets 22,24 and 26 may be constructed of polyvinylchloride, polyethylene, polypropylene or fluorinated ethylene polymer (such as Teflon (which is a registered trademark of Dupont) and are preferably flame retardant compositions capable of meeting the UL-910 Steiner flame requirements for CMP approval. However, in order to obtain Underwriters Laboratory approval (Type CMP) for this type of cable, it is necessary for the jacket to be easily separated from the conductor insulation when the jacket is cut by a knife. This is accomplished in many acceptable ways such as when both the jacket and insulation are made of the same or generally the same material, an appropriate release coating or separating tape is placed on the insulation before the jacket is extruded thereover. However, the preferable cable is when the conductor insulation and the jacket are made of different materials.

Jackets 22 and 24 are interconnected and separated by a first web 28, and jackets 24 and 26 are interconnected and separated by a second web 30. Preferably, the jacket 21 is an extruded jacket that is extruded onto the three insulated conductors to provide solid webs that are integral with the jackets 22,24,26. A polarity wing or key 40 extends from the end conductor jacket 22.

For the preferred flat cable, the webs 28 and 30 lie in the same plane and preferably extend from the diametric axis of the respective conductors 10,12 and 14. The polarity wing 40 preferably has the same thickness as the webs and extends in the same plane as the webs. This construction appears to give the best strength and reliability to the cable.

However, if it is desired, it may be possible to construct the key, conductor spacings and/or webs to have other configurations than that shown and still be within the intended invention.

The polarity wing 40 preferably extends from the jacket 22 diametrically opposite first web 28. The polarity wing 40 provides a key effect to ensure that a proper connection will be made between the cable 2 and an IDC connector or the like. The polarity of the conductors 10,12,14 are preselected depending on the system requirements. Preferably, the thicknesses of the first web 28, second web 30, and polarity wing 40 are substantially less than the minor dimension of the

cable. Advantageously, the said thicknesses can be less than $\frac{2}{3}$ of the minor dimension of said cable, e.g. one quarter of the minor dimension.

The dimensions of the components and the axial spacing may also vary depending on the design requirements, but should comply with any applicable safety standards. In the preferred embodiment for a three wire cable having a workable voltage of 40 V RMS maximum, a working current of 4 amps maximum and a conductor resistance maximum at 20°C of 11 OHMS/1000ft the conductor is stranded of copper having a 20 AWG (7 x 28), a diameter of about 0.01 ± 0.0013 cm (0.039 ± 0.0005 inches), insulated with Teflon (Registered Trade Mark) having a thickness of about 0.025 ± 0.005 cm (0.010 ± 0.002 inches) with a total diameter of the insulated conductor being about 0.015 ± 0.005 cm (0.059 ± 0.002 inches). The jacket surrounding each conductor is a flame resistant polyvinylchloride having an average thickness of 0.04 ± 0.008 cm (0.015 ± 0.003 inches) and thus, the insulated jacketed conductor has a diameter of about 0.23 ± 0.01 cm (0.089 ± 0.004 inches).

For example, in the particular example of a three-wire cable as shown in Figs. 1 and 2, the cable has three conductors of equal diameter of approximately 0.039 inches) and the thicknesses of the interconnecting webs 28,30 and polarity wing 40 are each approximately 0.05 cm (0.020 inches). The center conductor 12 is separated from the longitudinal centers of the two end conductors 10,14 by approximately 0.40 cm (0.156 inches). The thicknesses of the insulation around each conductor 10,12,14 is 0.25 cm (0.010 inches) and the thickness of the jackets 22,24,26 is approximately 0.38 cm (0.015 inches). The polarity wing 40 extends approximately 0.19 cm (0.075 inches) from the conductor 10.

Preferably, the material selection and cable design in accordance with the invention comply with the latest requirements of Underwriter Laboratory (Type CMP) and it meets the UL 910 Steiner flame requirements, thus allowing for air plenum installation.

Claims

1. A flexible jacketed flat cable (2) comprising:
 - a plurality of insulated conductors (10,12,14) in spaced relationship with each other,
 - a separate one-piece jacket (21) surrounding each insulated conductor (10,12,14), and
 - a web (28,30) interconnecting adjacent jacketed conductors (10,12,14), the thickness of said web or webs (28,30) being less than the minor dimension of said cable.
2. A flexible jacketed flat cable (2) comprising:
 - a plurality of insulated conductors (10,12,14) in spaced relationship to each other,
 - a separate one-piece jacket (21) surrounding all of said insulated conductors (10,12,14),
 - said one-piece jacket (21) separating said jacketed conductors (10,12,14) by a plurality of webs (28,30) interconnecting said jacketed conductors (10,12,14), the thickness of said webs (28,30) being less than the minor dimension of said cable (2); and a polarity wing (40) extending from said jacket (21) and said polarity wing (40) being integral with said jacket (21).
3. A cable as claimed in claim 1 or 2 wherein said conductors (10,12,14) lie in a common plane and are axially spaced.
4. A cable as claimed in claim 2 or 3 wherein the thickness of said polarity wing (40) is less than the minor dimension of said cable (2).
5. A cable as claimed in any of claims 1 to 4 wherein there are at least two of said conductors.
6. A cable as claimed in any of claims 1 to 5 wherein there are three of said conductors, said polarity wing (40) extending from one of the end conductors.
7. A cable as claimed in claim 6 wherein said conductors (10,12,14) have equal diameters and the thicknesses of each web (28,30) and said polarity wing (40) are approximately one fourth of said minor dimension of said cable (2).
8. A cable as claimed in claim 6 or 7 wherein each of said conductors (10,12,14) has a diameter of approximately 0.99 cm (.039 inches), and the thicknesses of said polarity of wing (40) and each web (28,30) are each approximately 0.05 cm (.020 inches).
9. A cable as claimed in any of claims 6 to 8 wherein the longitudinal center of the center conductor (12) is separated from the longitudinal centers of the two end conductors (10,14) by approximately 0.40 cm (.156 inches).
10. A cable as claimed in any of claims 6 to 9 wherein the thickness of each of said layer of insulation (16,18,20) is approximately 0.25 cm (.010 inches) and the thickness of each of said jackets (22,24,26) is approximately 0.04 cm (.015 inches), and wherein said polarity wing

(40) extends approximately 0.19 cm (.075 inches) from one of said conductors (10).

insulated conductor (10,12,14).

11. A cable as claimed in any of claims 1 to 5 wherein there are more than three of said conductors, said polarity wing (40) extending from one of the end conductors. 5
12. A cable as claimed in any of claims 2 to 11 wherein said polarity wing (40) and its adjacent web (28) are located diametrically opposite of said one (10) of said conductors. 10
13. A cable as claimed in any preceding claim wherein said conductor insulation (16,18,20) and said jacket (21) are of polyvinylchloride, polyethylene, polypropylene or fluorinated ethylene polymer. 15
14. A cable as claimed in any of claims 2 to 13 wherein said conductors (10,12,14) have equal diameters and the thicknesses of said web or webs (28,30) and said polarity wing (40) are less than $\frac{2}{3}$ of the minor dimension of said cable (2), the diameter of said conductors (10,12,14) is from about 0.09 to 0.10 cm (0.037 to 0.040 inches), the conductor insulation (16,18,20) has a thickness of approximately 0.20 to 0.30 mm (8 to 12 mils), the conductors (10,12,14) are axially spaced a distance from their center line of from about 0.37 to 0.42 cm (0.145 to 0.165 inches) and preferably 0.40 ± 0.01 cm (0.156 ± 0.005 inches) and the jacket (21) has a thickness of approximately 0.25 to 0.46 mm (10 to 18 mils); the polarity wing (40) extends from the outer surface of the conductor jacket (21) and is spaced from the center of the end conductor (10) a distance of at least 0.25 cm (0.10 inches), and the thickness of the webbing and polarity wing preferably are equal and are preferably from about 0.38 to 0.64 mm (15 to about 25 mils). 20
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15. A cable as claimed in claim 14 in which the polarity wing (40) extends from the periphery of the outer surface of the conductor jacket (21) by a distance greater than the distance between adjacent conductors. 45
16. A cable as claimed in any preceding claim in which each web (28,30) is integral with said plurality of jackets. 50
17. A cable as claimed in any preceding claim wherein said conductors are of copper. 55
18. A cable as claimed in any preceding claim in which each jacket is strippable from each in-

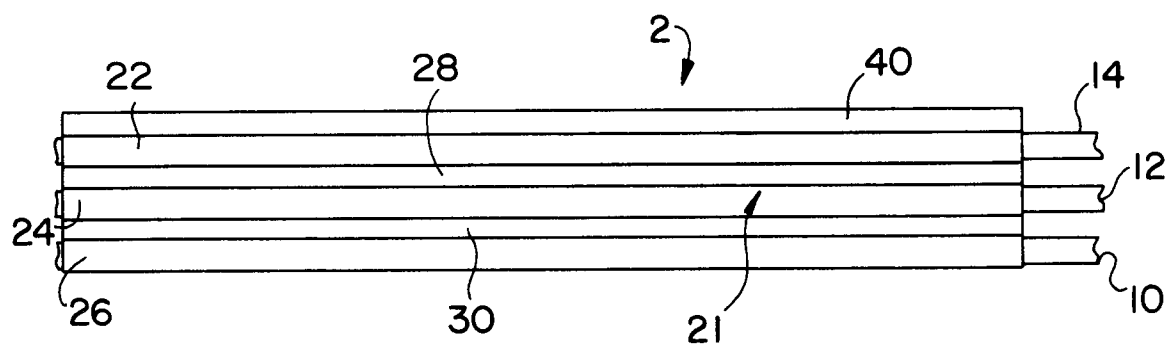


FIG. 1

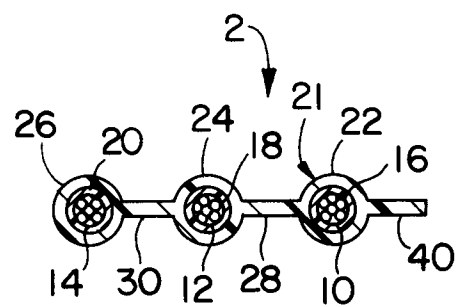


FIG. 2



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EUROPEAN SEARCH REPORT

Application Number

EP 93 30 3167

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	EP-A-0 041 097 (W.L. GORE & ASSOCIATES, INC.)	1,3,5,7,13	H05B3/56 H01B7/08
Y	* the whole document *	2	
Y	FR-A-1 529 809 (HOUILLÈRES DU BASSIN DU NORD ET DU PAS-DE-CALAIS) * claims 1,2 *	2	
X	DE-U-1 985 639 (FELTEN & GUILLEAUME CARLS WERK AG) * the whole document *	1,13	
A	DE-A-1 913 972 (SIEMENS AG)		
A	GB-A-2 047 947 (MOLEX INC.)		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			H05B H01B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 31 AUGUST 1993	Examiner DE SMET F.P.
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